

# Aerosol Insecticides and Control of Stored Product Insects

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# Introduction

- Aerosols (Fogs, ULVs) are liquid formulations, atomized and applied through a nozzle
- Kill exposed flying or crawling insects, do not penetrate food material, packaging, etc.
- We have been research for the last several years on various aspects of aerosols
- This talk will focus on some of those projects

# RFB and CFB-test species

## Why Use These Species?



# How We Evaluate an Aerosol

- Look at the percentage that are active after a different post-exposure time periods
- Look at those adults that are knocked down (on their backs and unable to turn upright)
- Determine mortality; unable to move when prodded with a probe

# Field Aerosol Application-Pyrethrin



# Questions Regarding Aerosols

- Do adult flour beetles recover from exposure if they have a food source?
- Does particle size affect control?
- Can we measure particle size?
- What are the dispersal patterns of aerosols in mills and warehouses?

# Tests with adult confused flour beetle

## Adult does not fly



# Lab Studies

- Done with an industry collaborator, MRIGlobal
- Examined aerosol dispensed at 2  $\mu\text{m}$  or 16  $\mu\text{m}$



# Spray Chamber



# Concrete Exposure Arena



# Spray Chamber



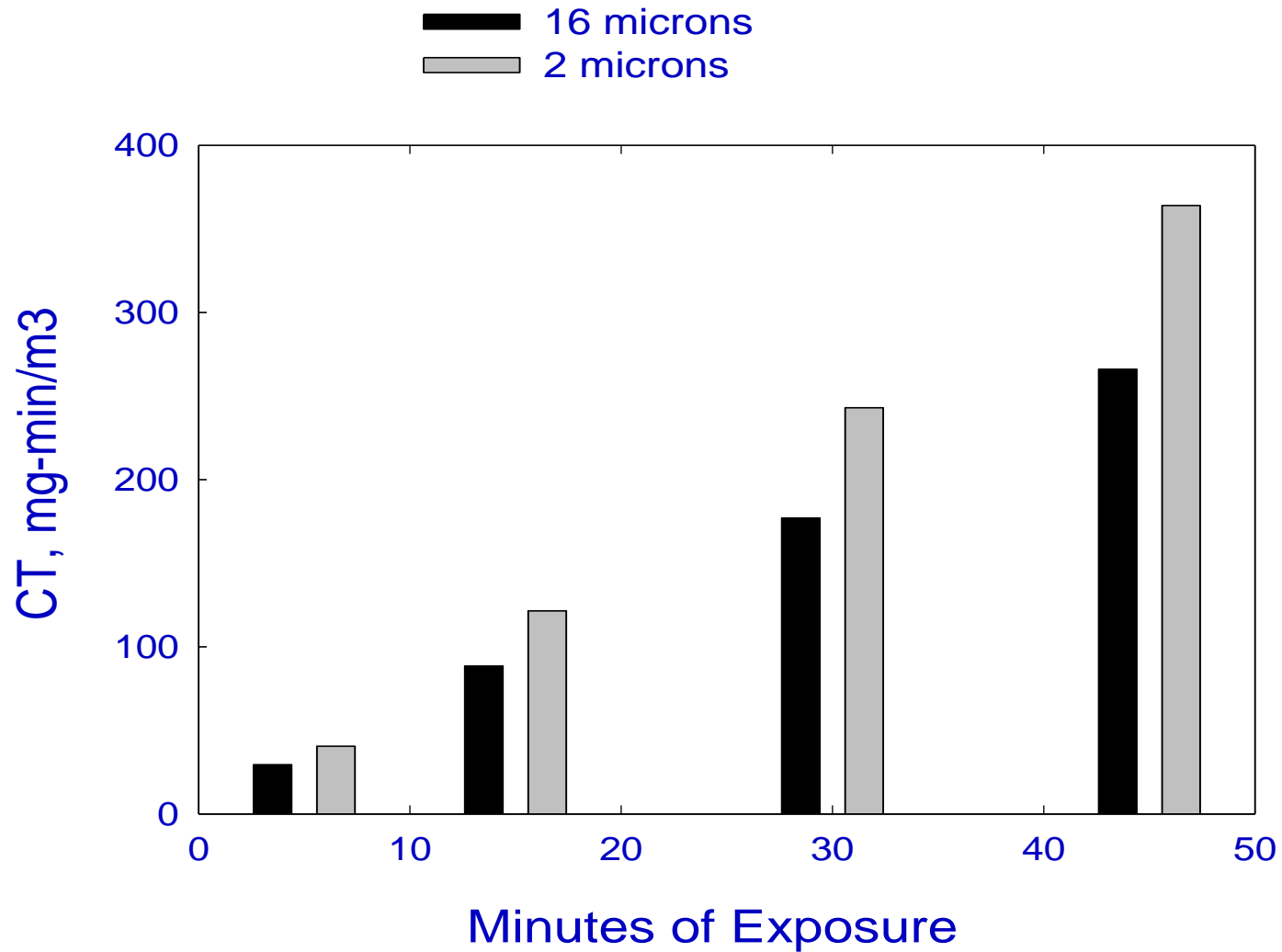
# Results

- 2 micron particle size clearly not effective
- As particle size is halved, the number of particles quadruples
- More particles did not = greater mortality

# Examination of Concentration

- Use a CT approach-concentration x exposure time to examine results
- Look for where CT overlaps
- Eliminate data for 2 micron ( $\mu\text{m}$ ) sprayer
- Compare data for Spraying Systems ( $16\mu\text{m}$ ) and Collison 24-jet ( $2\mu\text{m}$ ), 5, 15, 30, 45 min

# 24-Jet Collision-2 microns



# More Results

- Small particles did not deposit on the body surface of insects or on a concrete surface
- Arthur et al. J. Econ. Entomol. 107: 2239-2251
- What are the dispersal patterns of aerosols in mills and warehouses?

# Structural Complexity of Flour Mills



Equipment and Structures Block Aerosol Dispersal  
Distance from Sprayer and sprayer location are factors as well



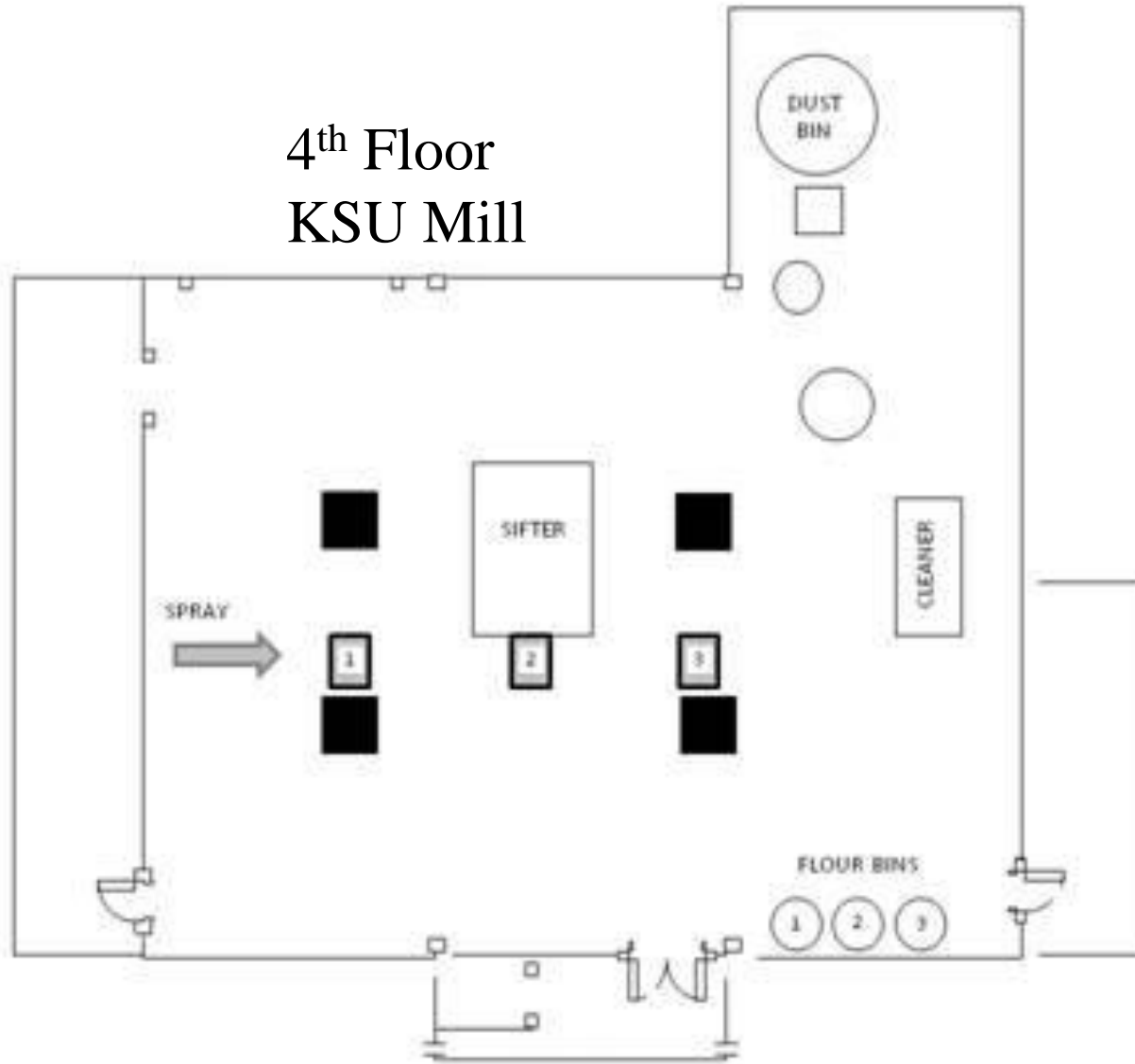
# APS Unit with Computer Measures particles 1-20 $\mu\text{m}$



# Field Trial at KSU Flour Mill

- Pyrethrin + methoprene IGR (Diacon<sup>®</sup> IGR) and pyrethrin + pyriproxyfen IGR (Nygard<sup>®</sup>)
- PY+D, used portable sprayer; PY+N, cylinderized formulation
- 3 APS units put out on open transect at 20, 35, and 50 ft from sprayer

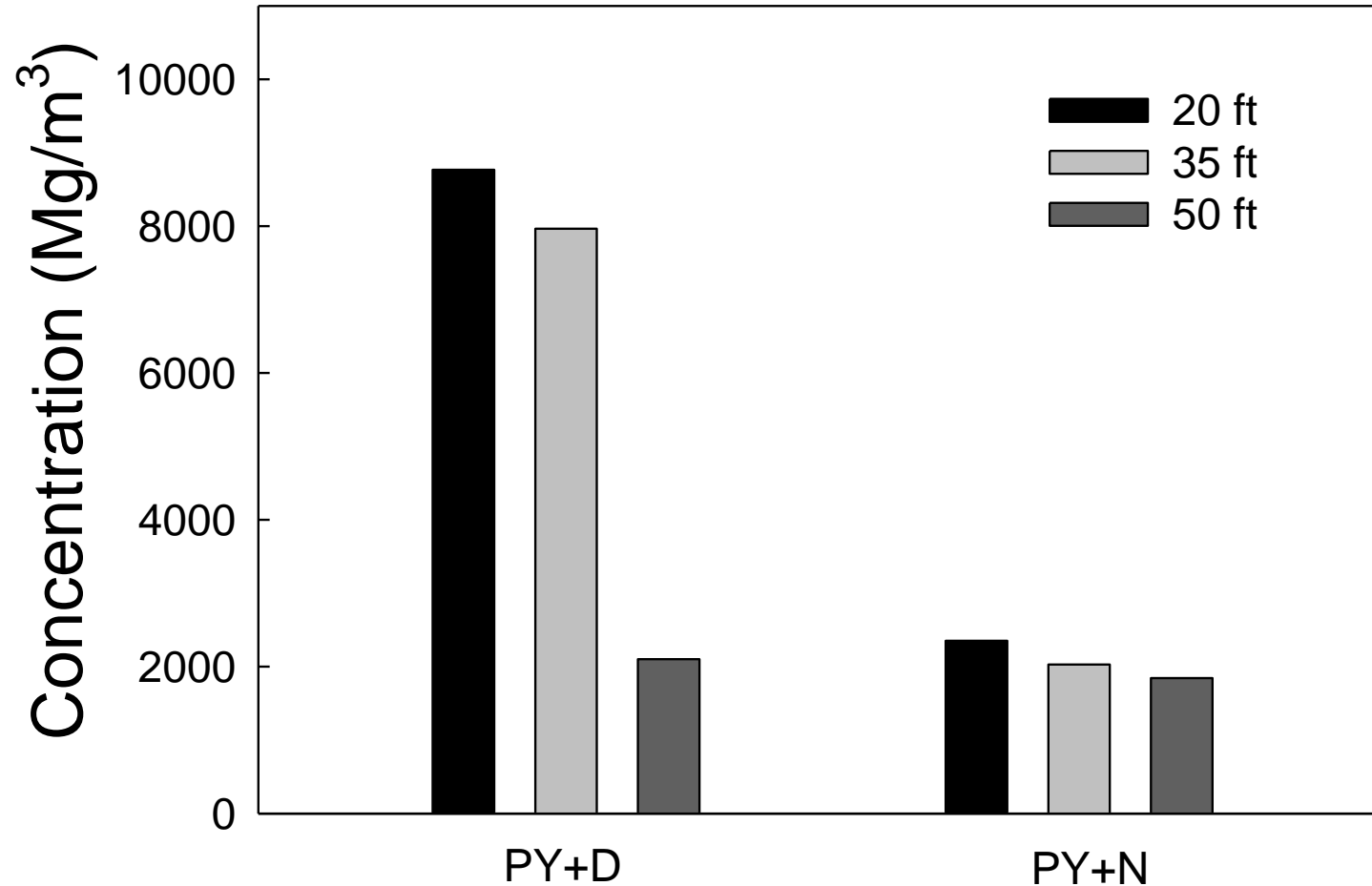
# 4<sup>th</sup> Floor KSU Mill



# Quick Results

- Particle size and dispersal patterns were the same with distance and insecticides
- But, concentration varied with insecticide and distance
- Some recovery at 50 ft with PY+D

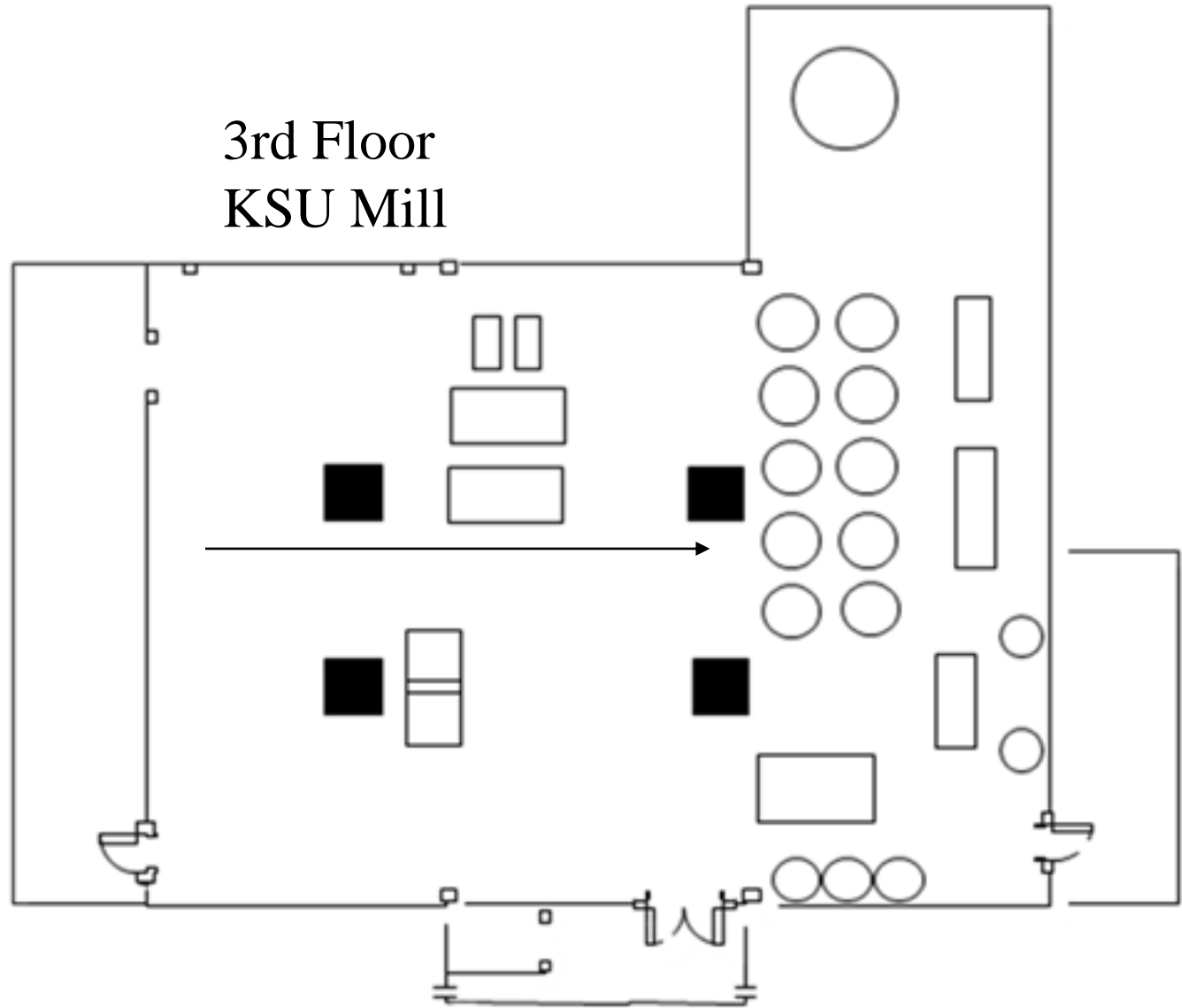
# Aerosol Dispersion



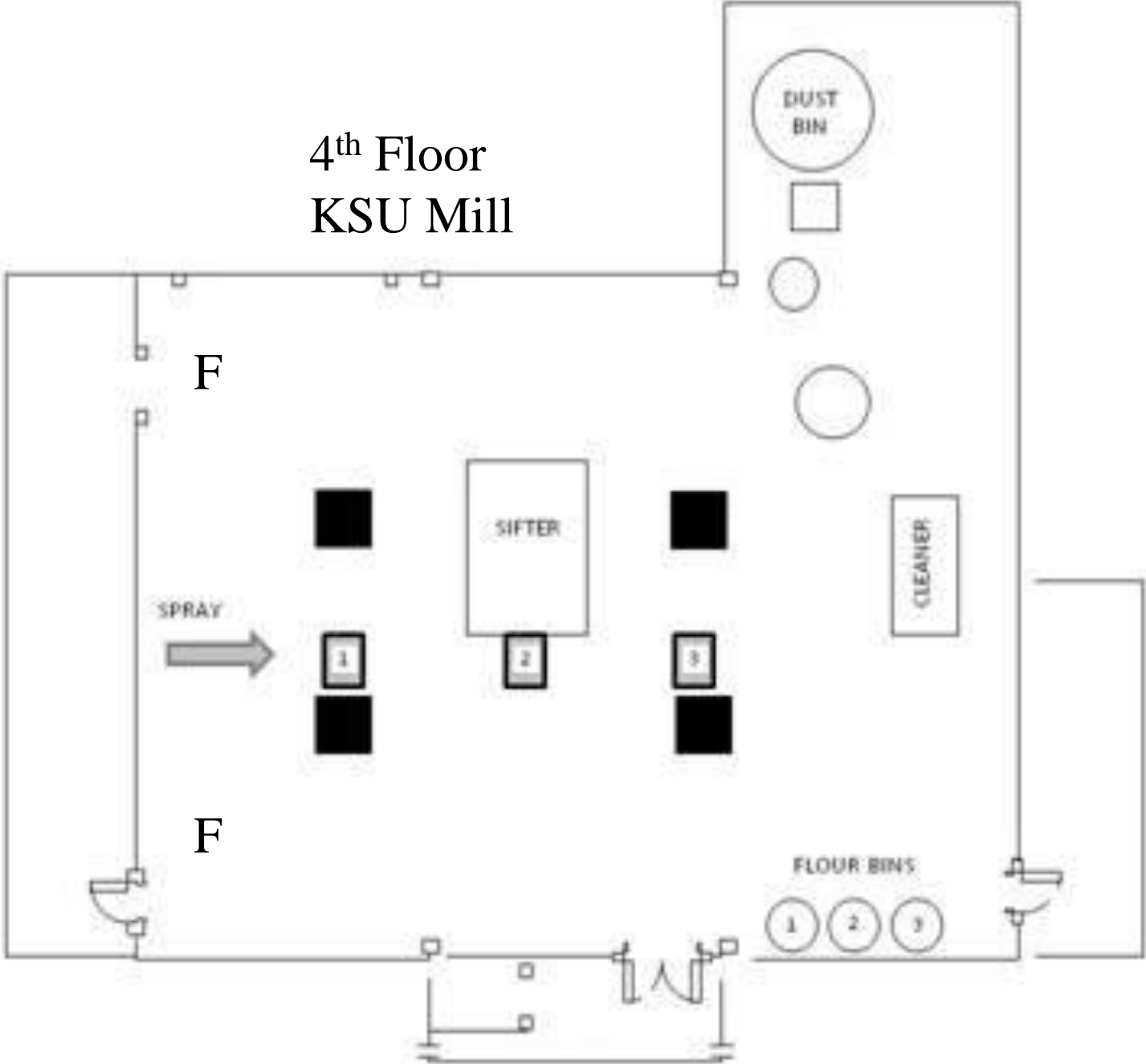
# Next Test

- Would the use of fans help aerosol dispersal?
- Test in KSU flour mill, used exposure times of 0.5, 1, and 2 hours, with and w/o fans
- APS units at 20, 358, and 50 ft on 4<sup>th</sup> floor; insect bioassays on floors 3-5
- Box fans and sprayer at south ends

3rd Floor  
KSU Mill

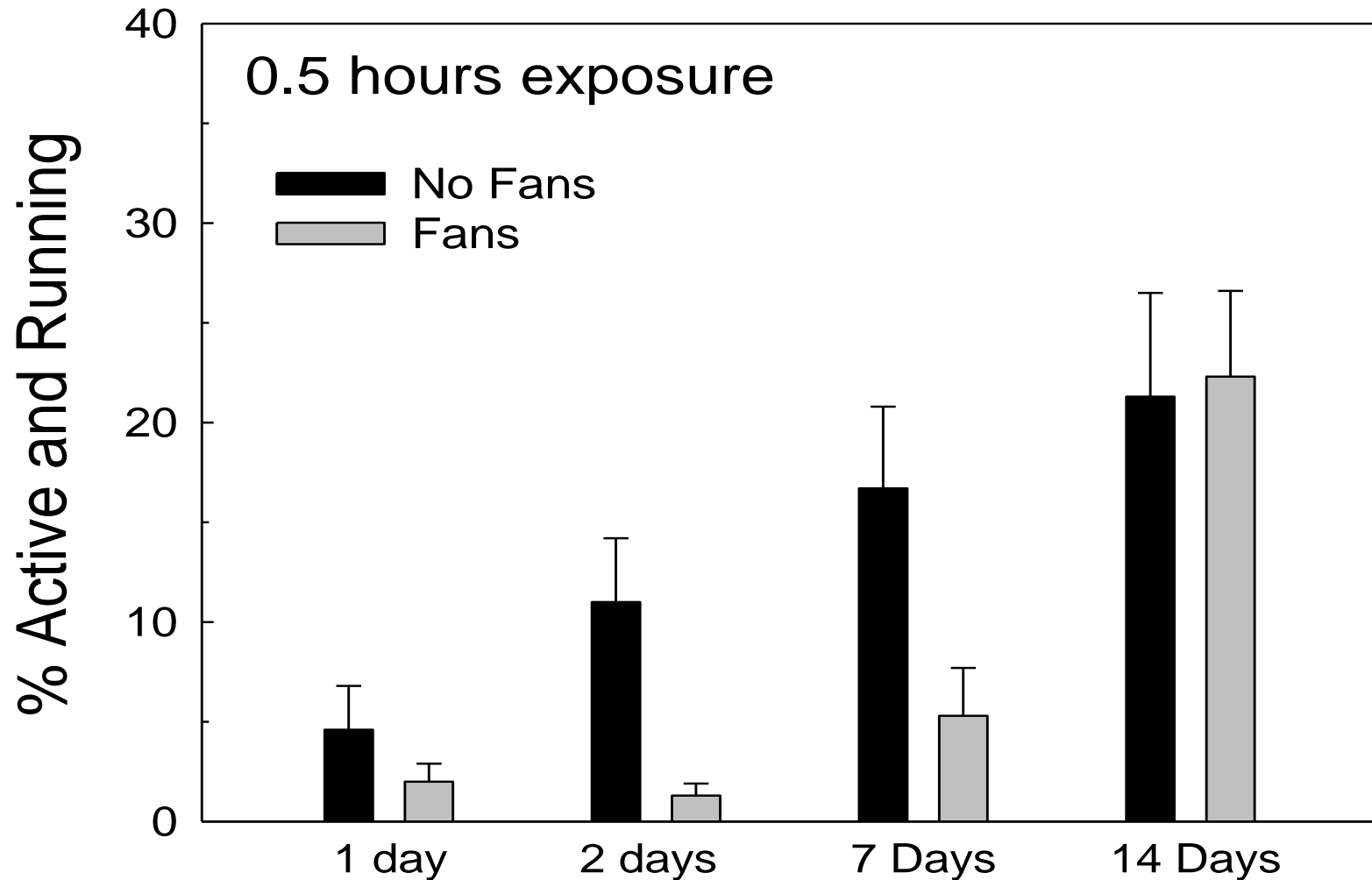


4<sup>th</sup> Floor  
KSU Mill

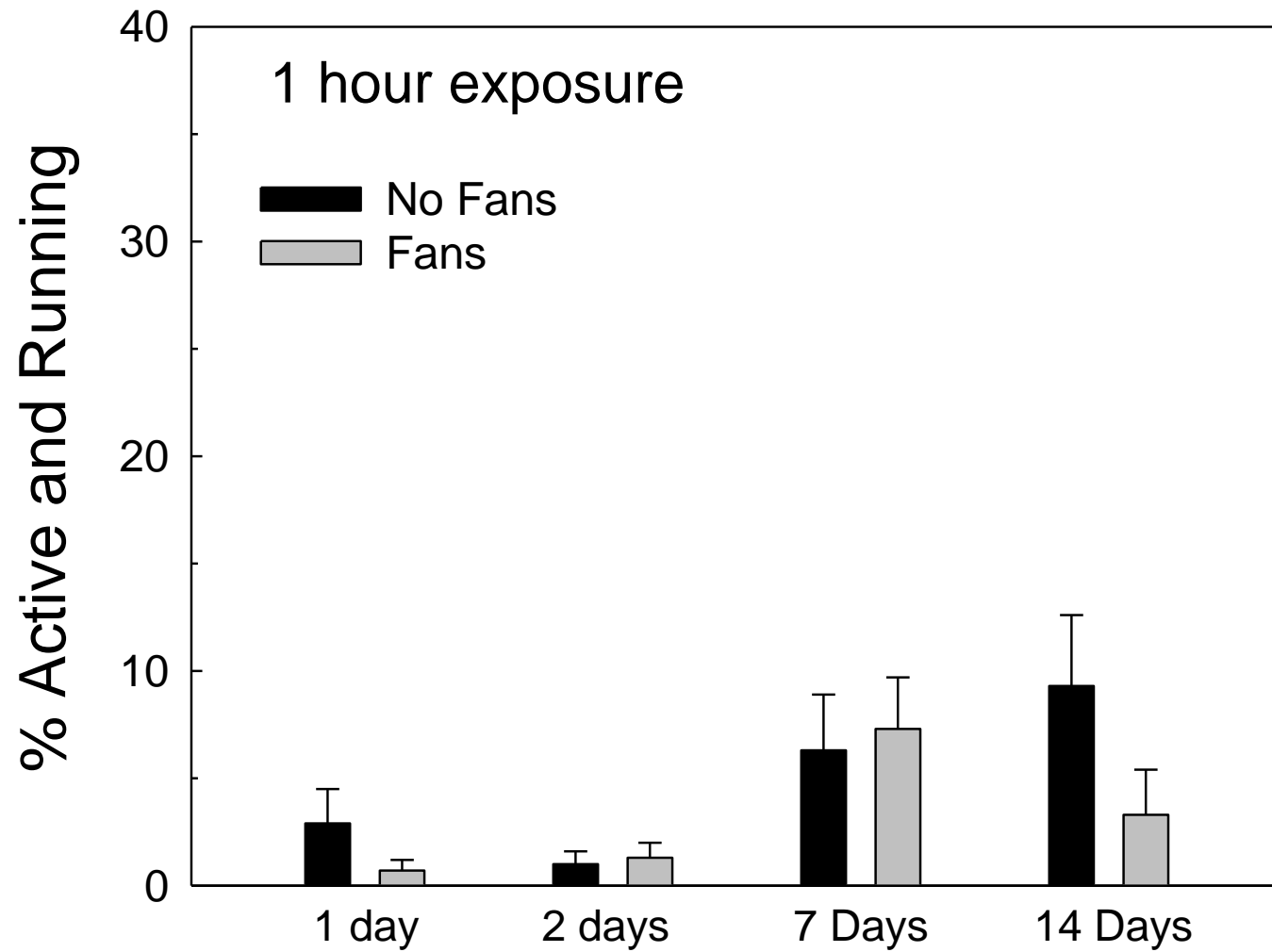




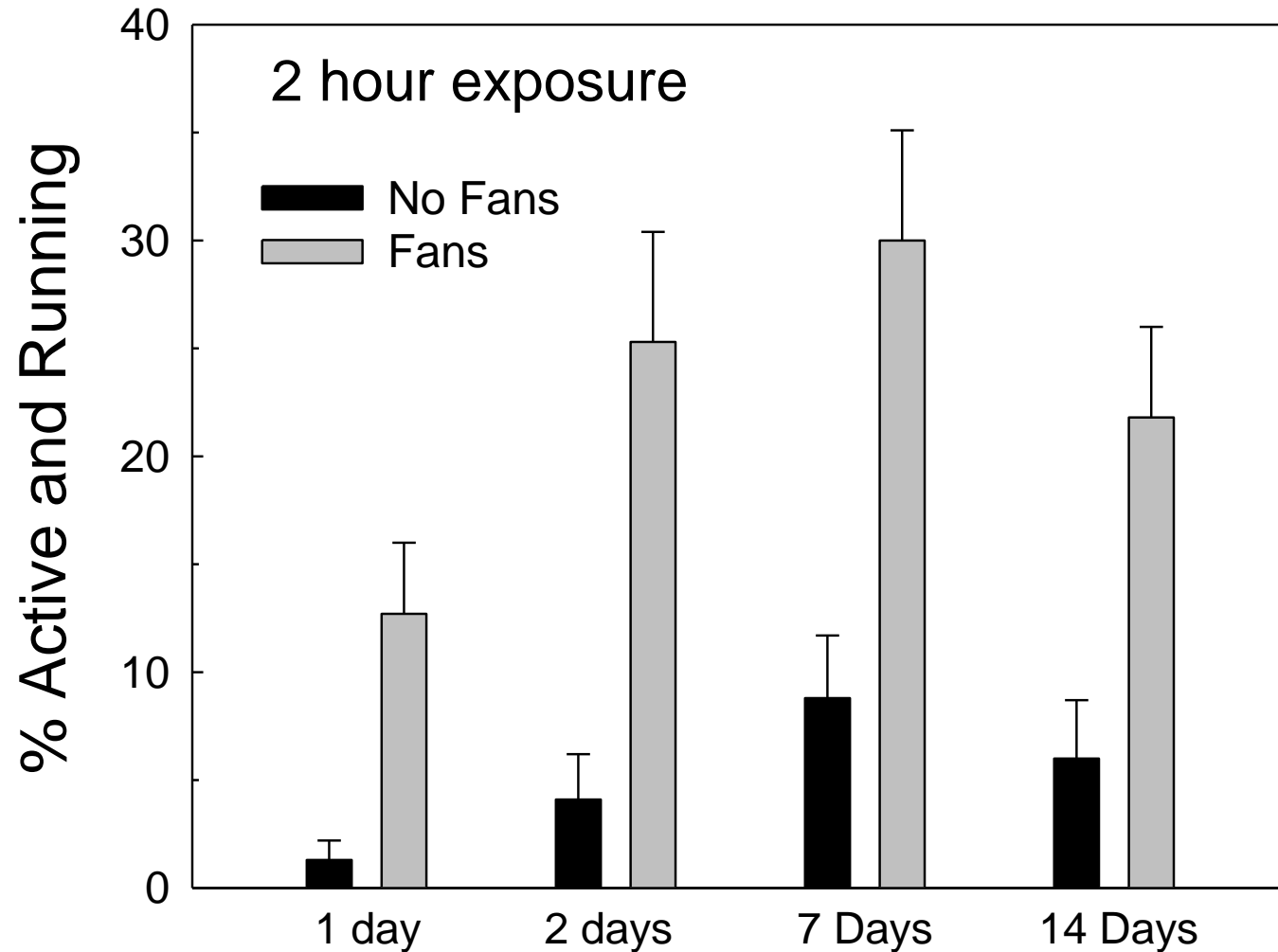
# Confused flour beetle bioassays



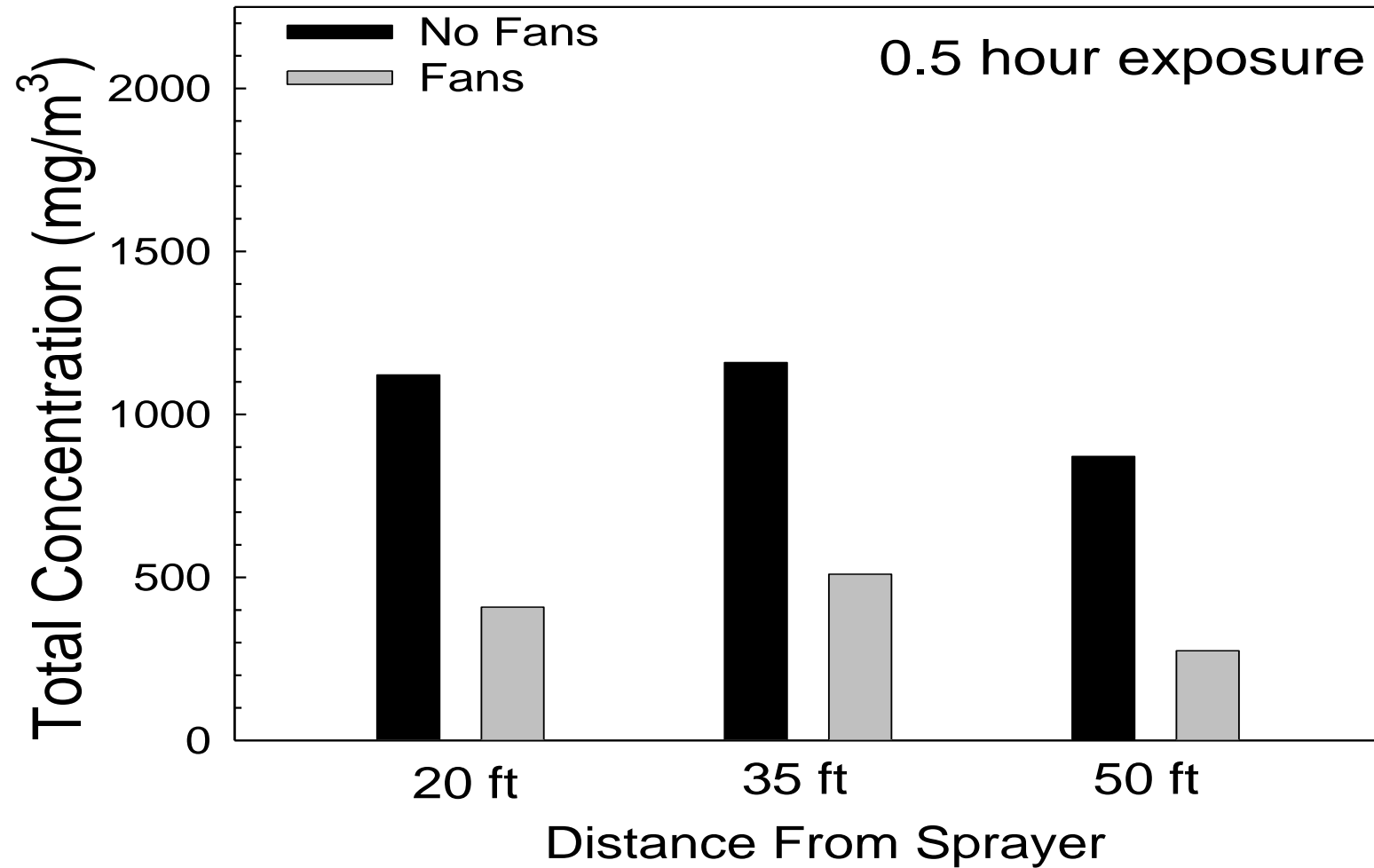
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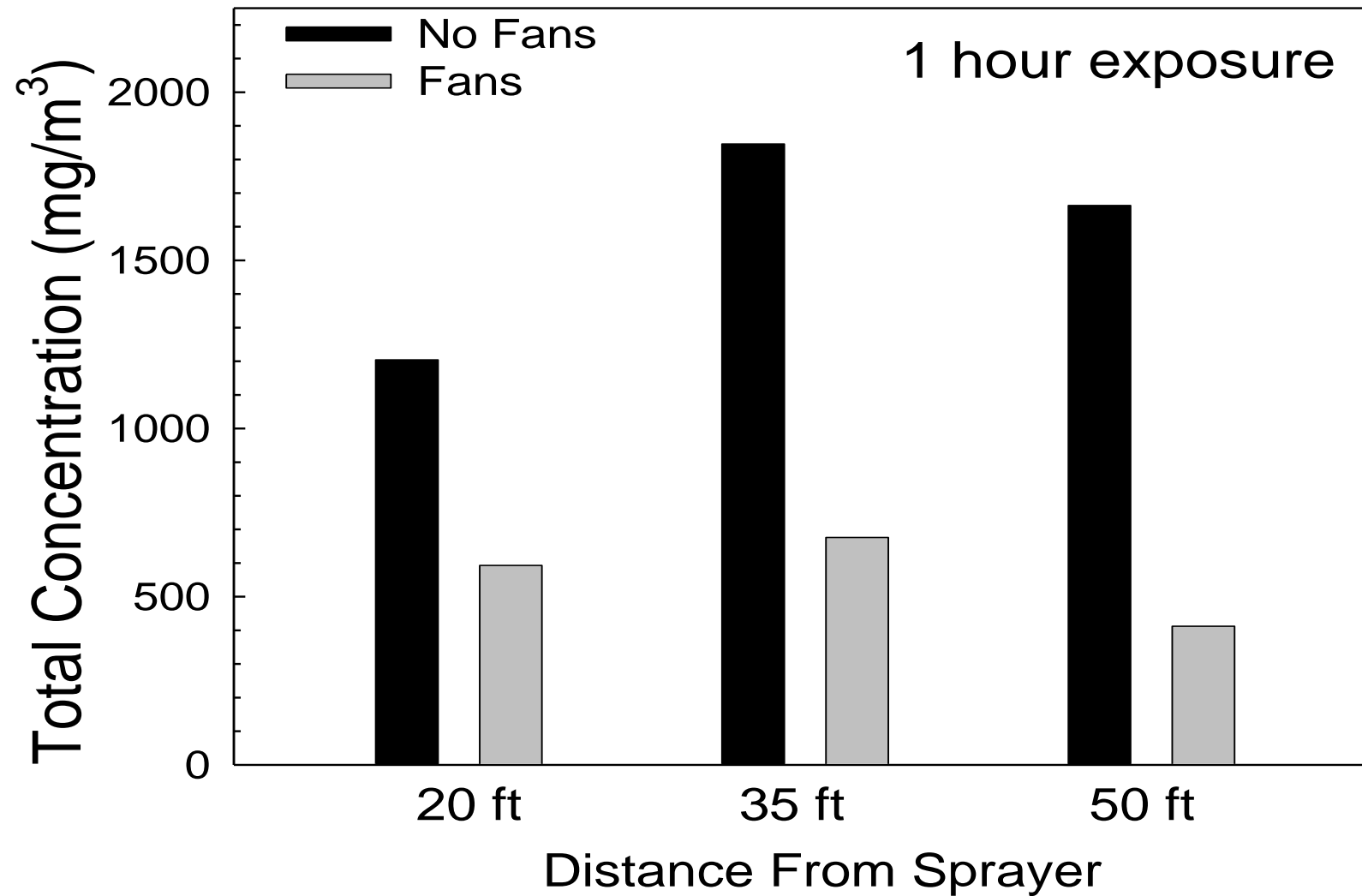
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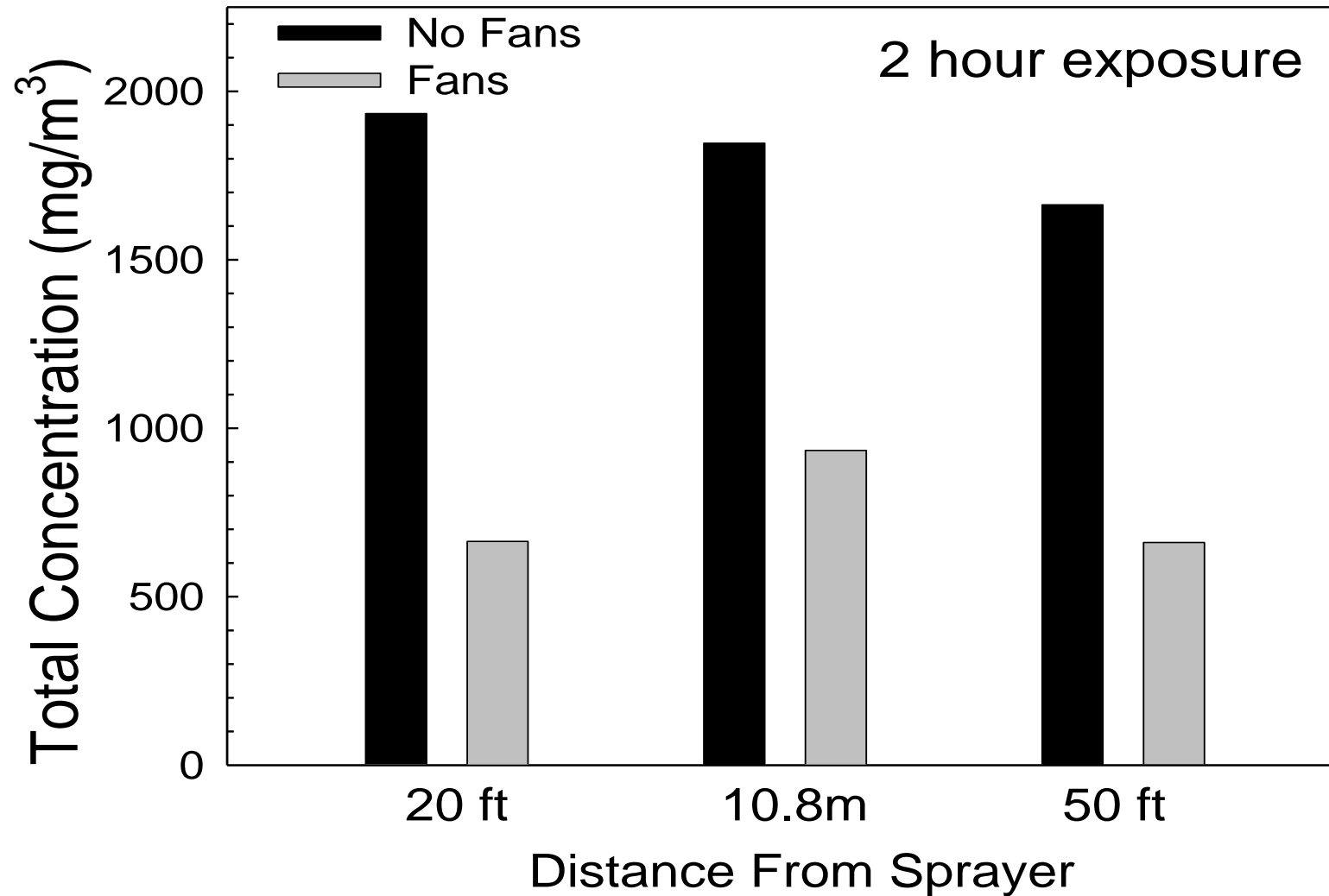
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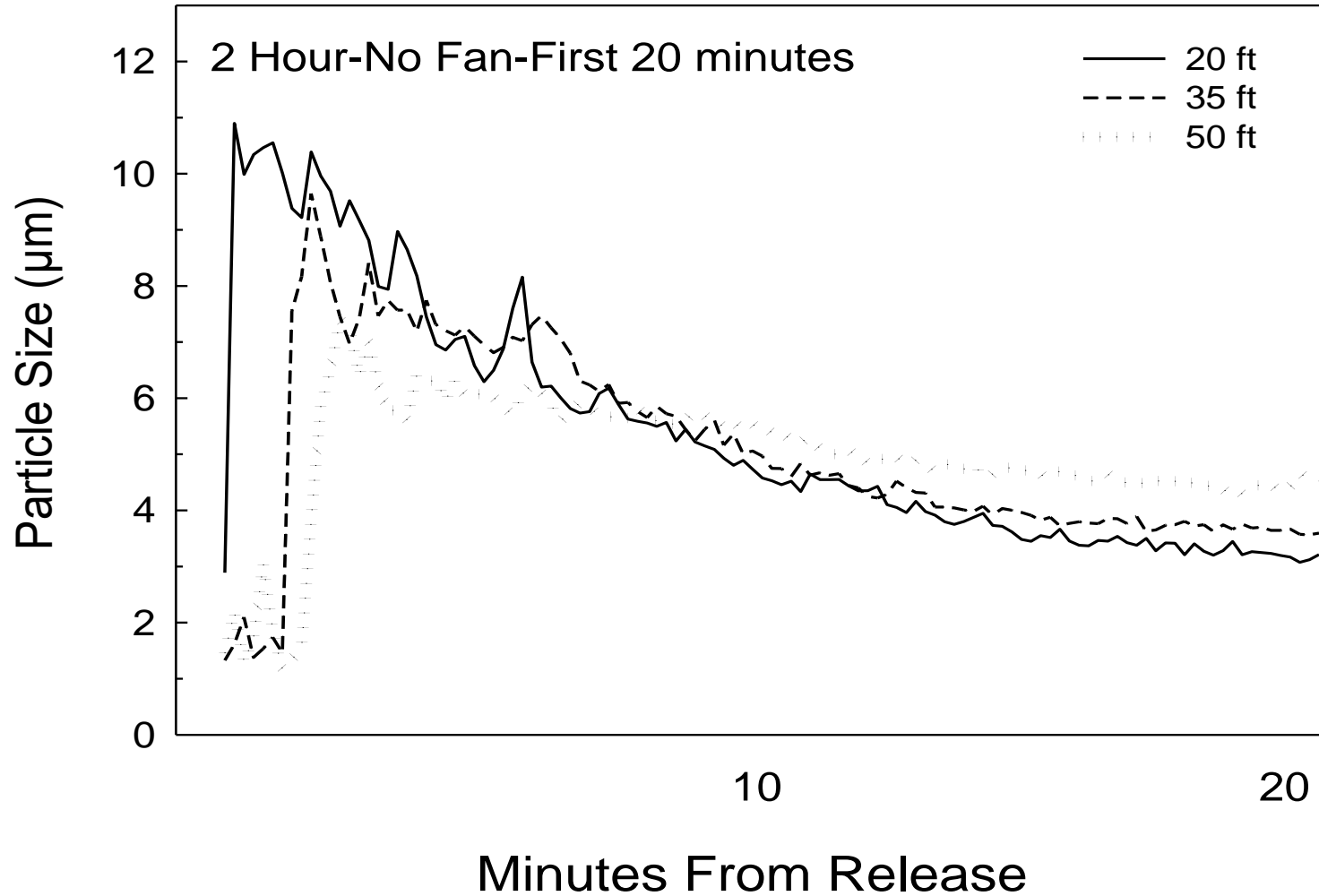
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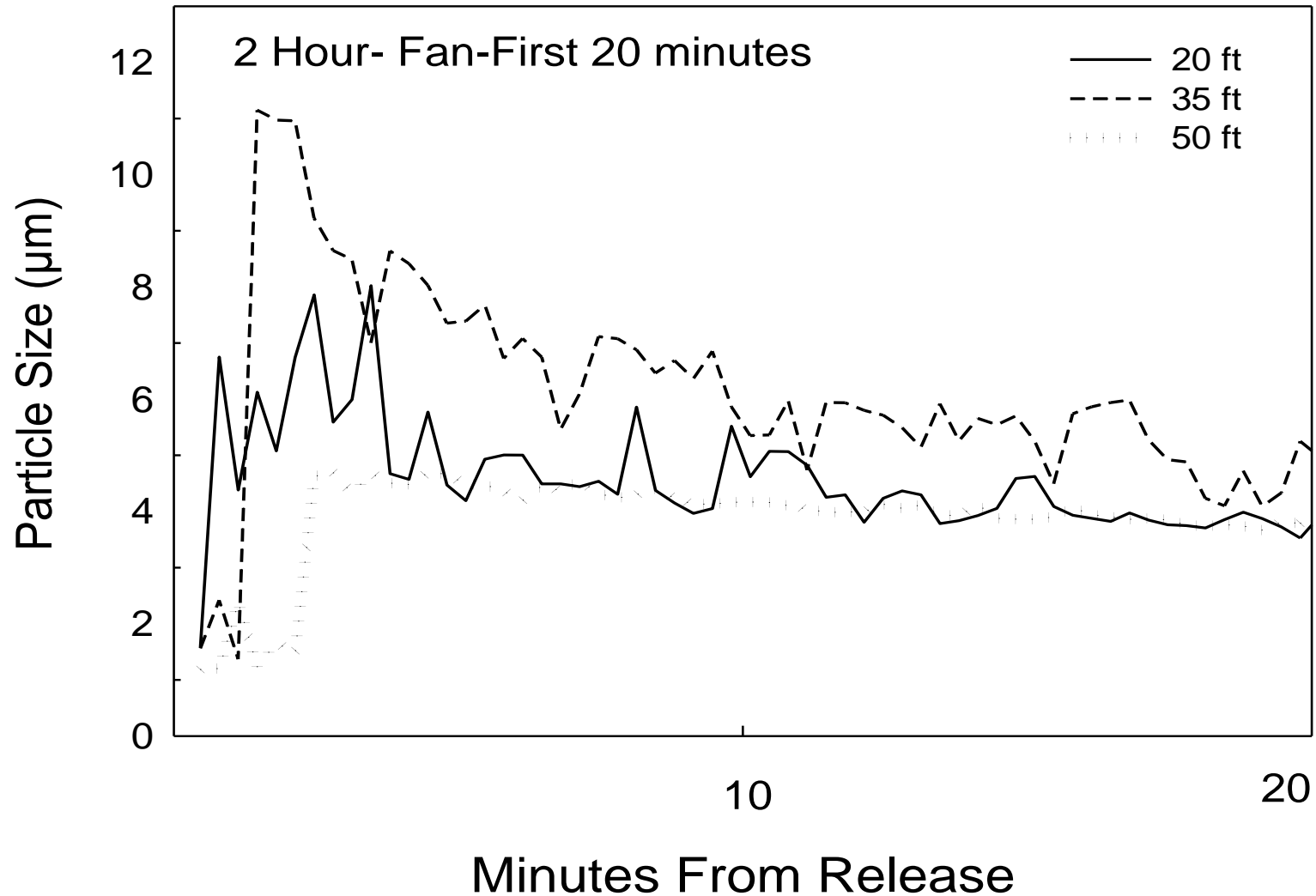
# Aerosol Dispersion



# Aerosol Particle Size

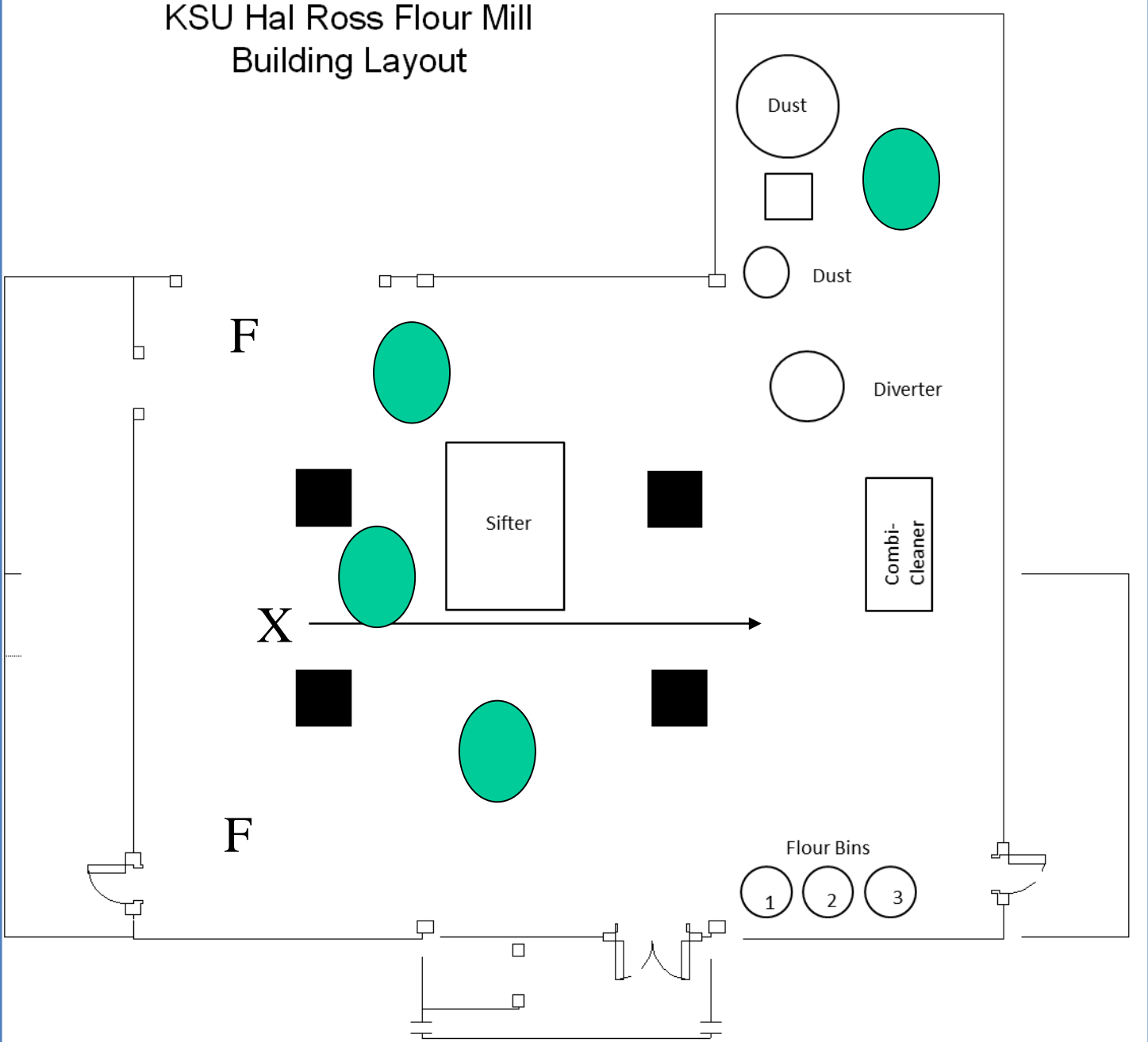


# Aerosol Particle Size





# KSU Hal Ross Flour Mill Building Layout



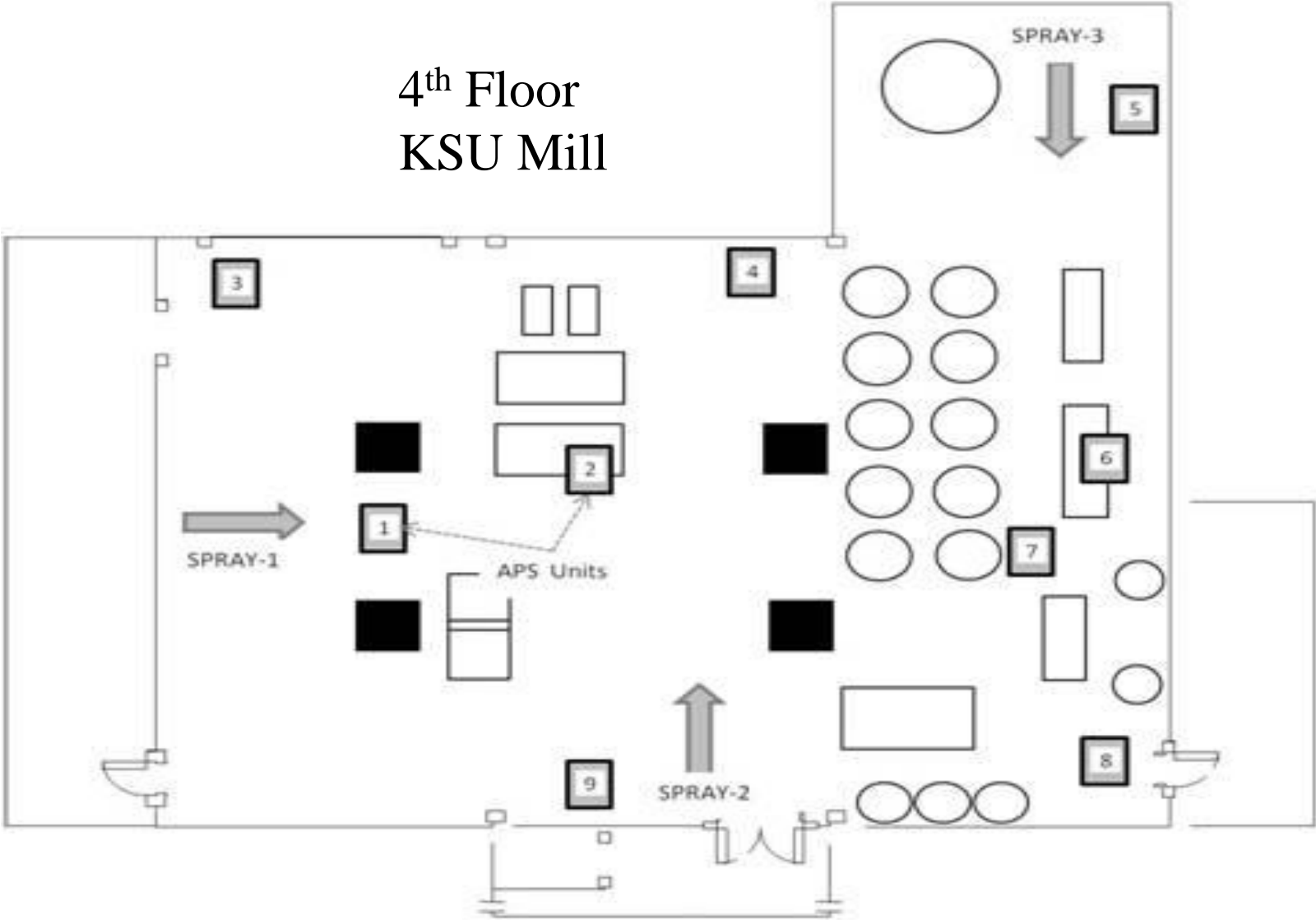
# What We Knew After These Tests

- There is definitely a distance effect along with blockage effects of mill equipment
- Fans at short exposure times (0.5 hr) seemed beneficial but not at longer times (2 hr)
- Most of the aerosol was dispensed in the first 10-15 minutes of application
- Shut down time for mills is lost production

# More Recent Tests

- 2016 field tests
- Moved position of sprayer, mixed results-  
equipment blocked dispersion
- Recovery of exposed adult beetles varied,  
depending on position of sprayer
- Need better dispersal of aerosols in mills

4<sup>th</sup> Floor  
KSU Mill



# Relevance for Industry

- Sanitation is important, the presence of food decreases aerosol efficacy
- Aerosol particle size and distribution have a huge effect on efficacy as well
- Field sites vary considerably in configuration, there are barriers to aerosol dispersal
- Awareness of these factors can improve pest management programs

# For More Information

- Research papers and insect photos on website, [ars.usda.gov/plains-area/mhk/cgahr/spieru/](http://ars.usda.gov/plains-area/mhk/cgahr/spieru/)
- [frank.arthur@ars.usda.gov](mailto:frank.arthur@ars.usda.gov)